Class XII Session 2023-24
Subject - Biology
Sample Question Paper - 5

Maximum Marks: 70 **Time: 3 Hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions. All questions are compulsory.
(iii) Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section- C has 7 questions of 3 marks each; Section- D has 2 case based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION - A

1. The function of copper ions in copper releasing IUDs is that they
(a) inhibit gametogenesis
(b) make uterus unsuitable for implantation
(c) inhibit ovulation
(d) suppress sperm motility and fertilising capacity of sperms.

2. Match List-I with List-II.

	List-I		List-II
(p)	Vaults	(i)	Entry of sperm through cervix is blocked
(q)	IUDs	(ii)	Removal of vas deferens
(r)	Vasectomy	(iii)	Phagocytosis of sperms within the uterus
(s)	Tubectomy	(iv)	Removal of fallopian tube

Choose the correct answer from the options given below.

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	p	q	r	s
(a)	(iii)	(i)	(iv)	(ii)
(b)	(iv)	(ii)	(i)	(iii)
(c)	(i)	(iii)	(ii)	(iv)
(d)	(ii)	(iv)	(iii)	(i)

3. If the total amount of adenine and thymine in a double stranded DNA is 55%, the amount of guanine in this DNA will be
(a) 45%
(b) 27.5%
(c) 25%
(d) 22.5%.

4. Hardy-Weinberg equilibrium is known to be essentially affected by factors like, gene flow, genetic drift, mutation, genetic recombination and
(a) evolution
(b) limiting factors
(c) saltation
(d) natural selection.

5. Identify the type of immunity obtained when a injection of antitoxin in tetanus is given?
(a) Active immunity
(b) Humoral immunity
(c) Passive immunity
(d) All of these

6. Which lymphoid organ atrophies with age?
(a) Bone marrow
(b) Peyer's patches
(c) Thymus
(d) Spleen

7. BOD is (i) in polluted water and (ii) in potable water.

(i)	(ii)
(a) more	less
(b) less	more
(c) less	less

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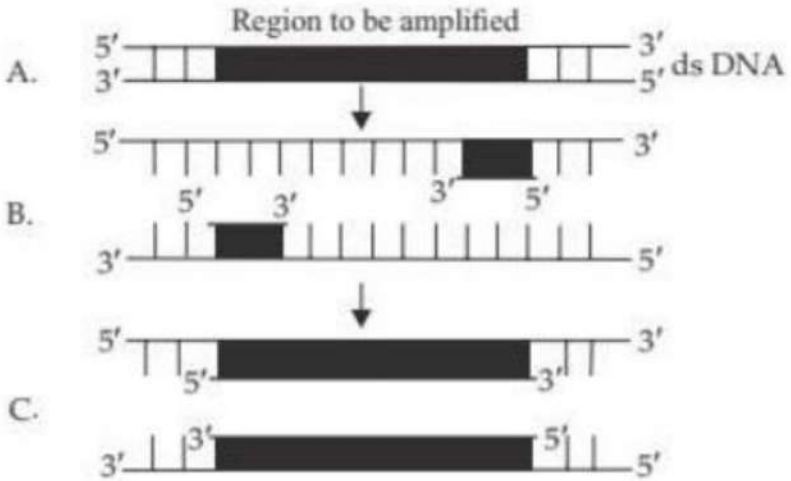
8. The figure below shows three steps (A, B, C) of Polymerase Chain Reaction (PCR). Select the option giving correct identification together with what it represents.



(a) B- denaturation at a temperature of about 98°C separating the two DNA strands
(b) A- denaturation at a temperature of about 50°C
(c) C-extension in the presence of heat stable DNA polymerase
(d) A- annealing with two sets of primers

9. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is
(a) 05
(b) zero
(c) 10
(d) 15.

10. Which interaction is shown when the invasive prickly pear cactus brought under control after introduction of moth from its natural habitat?
(a) Predation
(b) Amensalism
(c) Mutualism
(d) Competition

11. Mr. X is eating curd/yoghurt. For this food intake in a food chain he should be considered as occupying
(a) first trophic level
(b) second trophic level

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(c) third trophic level
(d) fourth trophic level.

12. In which of the following, both pairs have correct combination?
(a) In-situ conservation: Seed Bank
Ex-situ conservation: National Park
(c) In-situ conservation: National Park
Ex-situ conservation: Botanical Garden
(b) In-situ conservation : Tissue culture
Ex-situ conservation: Sacred groves
(d) In-situ conservation: Cryopreservation
Ex-situ conservation: Wildlife Sanctuary

Q. No. 13 to 16 consist of two statements - Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

13. Assertion: In angiosperms, the central cell after triple fusion becomes the primary endosperm cell.
Reason: Double fertilisation ensures that the nutritive tissue is formed before the zygote starts cleaving.

14. Assertion: When yellow bodied, white eyed Drosophila females were hybridised with brown-bodied, red eyed males; and F_1 progeny was intercrossed, F_2 ratio deviated from 9:3:3: 1.
Reason: When two genes in a dihybrid are on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental type.

15. Assertion: Organisations like GEAC are necessary to monitor GM researches and to test the safety of introducing GM organisms for public services.
Reason: GM researches can have unpredictable results which even can be disastrous when genetically modified organisms are introduced into the ecosystem.

16. Assertion: Predators maintain prey population under control.
Reason: Predators reduce the intensity of competition among competing prey species.

SECTION-B

17. Refer to the figure given below.

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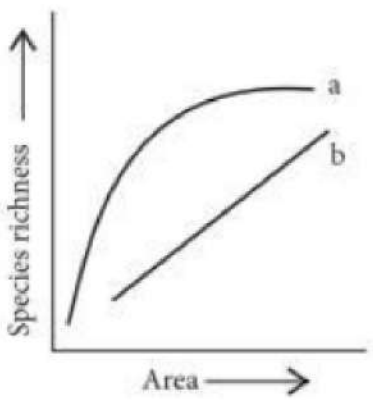
(a) Redraw the structure as a replicating fork and label the parts.
(b) Write the source of energy for this replication.

18. Where is sporopollenin present in plants? State its significance with reference to its chemical nature.

19. What could be the possible treatments for a patient exhibiting ADA deficiency?

20. Name the genus of baculovirus that acts as a biological control agent inspite of being a pathogen. Justify by giving three reasons that make it an excellent candidate for the job.

21. Refer to the given graph showing species-area relationship. Write the equation of the curve 'a' and explain it.



OR

How does over-exploitation of beneficial species affect biodiversity? Explain with the help of one example.

SECTION-C

22. Explain the steps in the formation of an ovum from an oogonium in humans.

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23. (a) Can a plant flowering in Mumbai be pollinated by pollen grains of the same species growing in New Delhi? Provide explanations to your answer.
(b) Draw the diagram of a pistil where pollination has successfully occurred. Label the parts involved in transferring the male gametes to their desired destination.

24. (a) What do 'Y' and 'B' stand for in 'YAC' and 'BAC' used for DNA sequencing in Human Genome Project (HGP)? Mention their role in the project.
(b) Write the percentage of human genome that codes for proteins and the percentage of discovered genes whose functions are unknown.
(c) Expand SNPs' identified by scientists in HGP.

25. (a) Explain adaptive radiation with the help of a suitable example.
(b) Cite an example where more than one adaptive radiation have occurred in an isolated geographical area. Name the type of a evolution your example depict and state why it is so named.

26. Why are lymph nodes and bone marrows called lymphoid organs? Explain the functions of each one.

OR

(a) Name the causative organisms for the following diseases :
(i) Elephantiasis
(ii) Ringworm
(iii) Amoebiasis
(b) How can public hygiene help control infectious diseases?

27. (a) Explain the basis on which the gel electrophoresis technique works.
(b) Write any two ways by which products obtained through this technique can be utilised.

28. Name and describe any three causes of biodiversity losses.

SECTION – D

Q. No. 29 and 30 are case based questions. Each question has 3 subparts with internal choice in one subpart.

29. In the given flow chart, the replication of retrovirus in a host is shown. Observe and answer the following questions.

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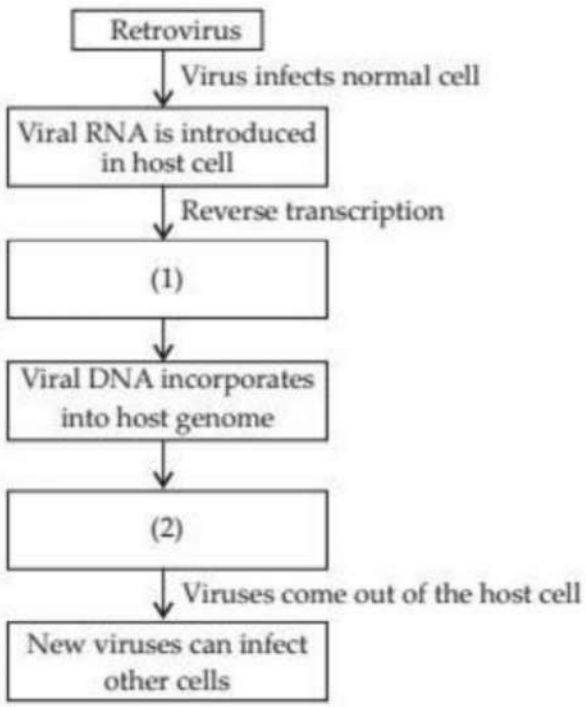


(a) What can be placed in blanks (1) and (2)?

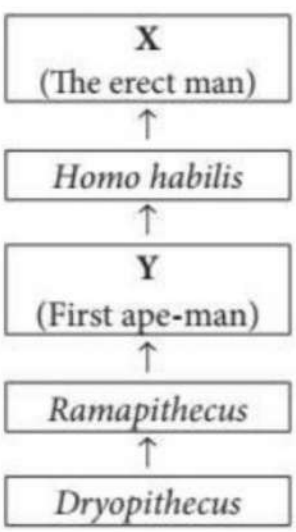
OR

Can the infected cell survive while viruses are being replicated and released?

(b) Why is the virus called retrovirus? Give one example.

(c) Name the disease which is caused by a retrovirus. How this virus gets transmitted?

30. Human evolution is a lengthy evolutionary process within the history of primates. The stages given here show the order of evolutionary history of man.



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(a) Identify 'X' and 'Y'.
(b) What was the brain capacity of 'X'?
(c) Give some important features of 'Y'.

OR

When was 'X' discovered?

SECTION-E

31. Reproductive and Child Health Care (RCH) Programmes are currently in operation. One of the major tasks of these programmes is to create awareness amongst people about the wide range of reproduction related aspects as this is important and essential for building a reproductively healthy society.
(a) "Providing sex education in schools is one of the ways to meet this goal." Give four points in support of your opinion regarding this statement.
(b) List any two indicators' that indicate a reproductively healthy society.

OR

(a) Mention the event that induces the completion of the meiotic division of the secondary oocyte.
(b) Trace the journey of the ovum from the ovary, its fertilisation and further development until the implantation of the embryo.
32. State and explain the "law of independent assortment" in a typical Mendelian dihybrid cross.

OR

A tall pea plant bearing violet flowers is given with its unknown genotypes. Explain by working out the crosses how would you find the correct genotypes with respect to the two traits mentioned only by "selfing" the given plants.

33. (a) Mention the number of primers required in each cycle of polymerase chain reaction (PCR). Write the role of primers and DNA polymerase in PCR. Give the characteristic feature and source organism of the DNA polymerase in PCR.
(b) Rearrange the following in the correct sequence to accomplish an important biotechnological reaction:
(i) Denaturation of ds-DNA
(ii) Chemically synthesised oligonucleotides
(iii) Primers

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(iv) Complementary region of DNA
(v) Thermostable DNA polymerase (from Thermus aquaticus)
(vi) Nucleotides provided
(vii) Genomic DNA template
(viii) In vitro synthesis of copies of DNA of interest

OR

(a) Draw pBR322 cloning vector. Label 'ori, 'rop' and any one antibiotic resistance site on it and state their functions.
(b) State the role of 'biolistic gun' in biotechnology experiments.

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SOLUTIONS

1. (d): Copper releasing IUDs (e.g., CuT, Cu7 and multi load 375) are placed in the uterus of the females. Copper ions released by them suppress motility and fertilising capacity of the sperms.

2. (c)

3. (d): According to the Chargaff's rule, A = T and G = C A + G = T + CA + T = 55% So, A = 27.5 than T = 27.5% G+ C = 100 - 55% = 45% G = C = 22.5%

4. (d): Hardy-Weinberg principle describes a theoretical situation in which a population is undergoing no evolutionary change. It states that allele frequencies in a population are stable and constant from generation to generation. There are five factors that affect Hardy- Weinberg Principle. These are - mutation, gene flow, genetic drift, genetic recombination and natural selection.

5. (c): If a person is infected with some deadly microbes, a quick immune response is required against microbes. This quick response can be initiated by directly injecting the preformed antibodies or antitoxin. This type of immunisation is called passive immunisation.

6. (c)

7. (a)

8. (c): In the given figure of PCR A, B and C are denaturation, annealing and extension respectively.

9. (b): Natality and immigration positively contribute to the population growth while mortality and emigration are negative factors. In the given question, The net increase in population is natality + immigration = 250 + 20 = 270 The net decrease in population is mortality + emigration = 240 + 30 = 270 Thus, net increase in population = 270 - 270 = 0

10. (a)

11. (c): Mr. X eating curd/yoghurt should be considered as occupying third trophic level. Producers or green plants (first trophic level) are consumed by herbivores (second trophic level) and from them curd/ yoghurt (made from dairy breed) is consumed by third trophic level organisms like man.

12. (c): In-situ (on site) conservation is conservation and protection of the whole ecosystem and its biodiversity at all levels, in order to protect the threatened species. Two in-situ methods are being used to save biodiversity viz., hotspots and protected areas.

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Protected areas include National parks, sanctuaries, biosphere reserves and sacred groves. Ex-situ (off site) conservation is conservation of selected rare plants/ animals in places outside their natural homes. Ex-situ conservation includes botanical garden, zoological parks, seed banks, gene banks, in vitro fertilisation, cryopreservation techniques and tissue culture.

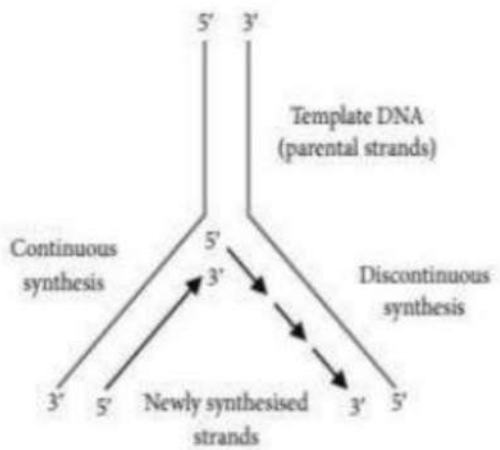
13. (a)

14. (a): In Drosophila, the genes for body and eye colour are located on X chromosome. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combination are higher than non-parental type. This occurs due to physical association or linkage of the two genes while non-parental gene combinations due to recombination between two genes. Thus, linkage and recombination deviates the ratio from Mendelian ratio of a dihybrid cross, i.e., 9: 3: 3: 1.

15. (a)

16. (a): Predation is an interaction between members of two species in which members of one species capture, kill and eat up members of other species. The former are called predators while the latter are termed as preys. Predators also help in maintaining prey population under control by reducing the intensity of competition among competing prey species.

17.



(b) The sources of energy for the replication of DNA are phosphorylated nucleotides or deoxyribonucleoside triphosphates i.e., dATP, dCTP, dGTP and dTTP.

18. Sporopollenin is present in exine layer of pollen grains. Sporopollenin is highly resistant fatty substance which is not degraded by any enzyme and

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not affected by high temperature, strong acid or strong alkali therefore pollen grains can be well preserved as microfossils.

19. The possible treatments that can be given to a patient exhibiting adenosine deaminase (ADA) deficiency are:
(i) bone marrow transplantation
(ii) enzyme replacement therapy.

20. Nucleopolyhedrovirus, a genus of baculovirus that act as a biological control agent inspite of being a pathogen.
(i) They are species specific.
(ii) They are narrow spectrum bioinsecticides.
(iii) There is no side effect on plants, mammals, birds/
fish and non-targent insects. Beneficial insects are conserved.

21. The equation of curve 'a' is S = CA where,
S = Species richness
C = Y - intercept
A = Area
Z = Slope of the line (regression coefficient). The graph of species - area relationship shows that within a region, species richness increases with increasing explorable area, but only upto a certain limit. The relation between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola.

OR

Excessive exploitation of a species, whether a plant or animal, reduces size of its population so that it becomes vulnerable to extinction. For example, presently many marine fish population around the world are declining due to over harvesting results in endangering the continued existence of some commercially important species.

22. The process of formation of a mature female gamete (ovum) is called oogenesis. It occurs in the ovaries. It consists of three phases: multiplication, growth and maturation.
(i) Multiplication phase development, certain cells in the germinal epithelium of the ovary of the fetus are larger than others. These cells divide by mitosis, producing a couple of million egg mother cells or oogonia in each ovary of the fetus.
(ii) Growth phase: This phase of oogenesis is very long. In this phase, oogonium enters into prophase-I of meiotic division and gets temporarily arrested at this stage, forming the primary oocyte. Each primary oocyte gets surrounded by a layer of granulosa cells, forming primary follice. The new layers of granulosa cells are added and the primary follicle modifies into

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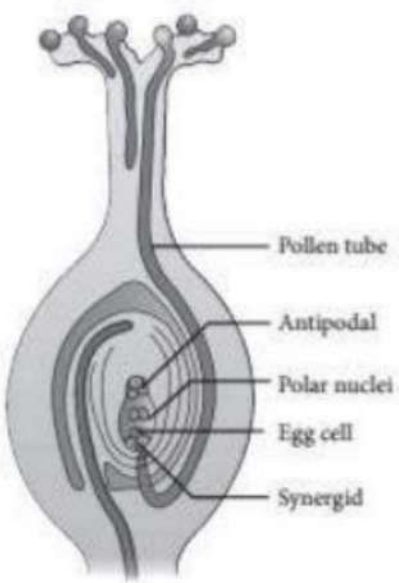
secondary follice. A fluid filled cavity called antrum develops in secondary follicle and its theca differentiates into interna and externa. This follicle is called tertiary follicle. Tertiary follicle grows in size, secondary oocyte and a polar body develop inside the tertiary follicle.

(iii) Maturation phase: The tertiary follicle further changes into the mature follicle or Graafian follicle. A layer called zona pellucida develops around the secondary oocyte. Now the Graafian follicle ruptures to release the secondary oocyte (or ovum). This process is called ovulation.

23. (a) Yes, a plant flowering in Mumbai can be pollinated by pollen grains of the same species of flower growing in New Delhi. This can be done by preserving the pollen grains and bringing them from New Delhi to Mumbai. Now, with the help of artificial hybridisation techniques, the pollen grains are dusted over the pistil to complete the process of pollination.
(b) Longitudinal section of pistil showing the parts involved in transferring the male gametes to desired destination is shown a head:



24. (a) 'Y' stands for yeast in YAC (yeast artificial chromosomes) and 'B' stands for bacterial in BAC (bacterial artificial chromosomes). YAC and BAC are specialised vectors used to create a large number of copies of DNA fragments so that they subsequently can be sequenced.
(b) In human genome, less than 2 percent of the genome codes for proteins and functions of only 50% of discovered genes are known.
(c) Expanded form of SNPs is Single Nucleotide Polymorphism.

25. (a) The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. Darwin's finches represent one of the best example of this phenomenon, as many varieties of finches were observed to be present on the same island. All the varieties, evolved on the island

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itself from the original seed-eating finches that lead to various modifications in the finches according to their food habits. This evolution in finches enabled the birds to become insectivorous, vegetarian, wood pecking, ground feeding, etc.
(b) A number of marsupials, each different from the other evolved from an ancestral stock, but all within Australian island continent. As similar adaptive functional structures develop in unrelated group of organisms so, it is called adaptive convergence or convergent evolution.

26. Lymph nodes and bone marrows are called lymphoid organs as these are the sites for proliferation, maturation and interaction of lymphocytes with antigens. Bone marrow is the primary lymphoid organ where lymphocytes mature and acquire their antigen- specific receptors.
Lymph nodes are secondary lymphoid organs which serve to trap the microorganisms or other antigens.

This further activates lymphocytes present there and cause the immune response.

OR

(a) (i) Elephantiasis - Wuchereria bancrofti
(ii) Ringworm - Microsporum sp.
(iii) Amoebiasis - Entamoeba histolytica
(b) Maintenance of public hygiene is very important for prevention and control of many infectious diseases. Public hygiene includes proper disposal of waste and excreta, periodic cleaning and disinfection of water reservoirs, pools and tanks and observing standard practices of hygiene in public catering. These measures are particularly essential where the infectious agents are transmitted through food and water such as typhoid, amoebiasis and ascariasis.

27. (a) After the cutting of DNA by restriction enzyme, fragments of DNA are formed. Separation of DNA fragments according to their size or length is done by a technique called agarose gel electrophoresis. It is a technique of separation of molecules such as DNA, RNA or protein, under the influence of an electrical field, so that they migrate in the direction of electrode bearing the opposite charge, viz., positively charged molecules move towards cathode (-ve electrode) and negatively charged molecules travel towards anode (+ve electrode) through a medium/ matrix. Most commonly used matrix is agarose. DNA fragments separate according to their size through sieving effect provided by agarose gel. Hence the smaller, the fragment size, the farther it moves. The separated DNA fragments can be seen only after staining the DNA with a compound known as ethidium bromide (EtBr) followed by exposure to UV radiation. The fragments are visible as bright orange coloured hands.
(b) The product obtained through gel electrophorosis can be used in the following ways:

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(i) Fragments of DNA obtained can be used to construct a recombinant DNA molecule by joining them with cloning vector
(ii) The desired DNA fragment can be amplified using polymerase chain reaction (PCR).

28. The three major causes of biodiversity loss are:
(i) Habitat loss and fragmentation-Over-population, urbanisation and industrialisation require additional land every year. It can come through destruction or fragmentation of natural habitats through filling wetlands, ploughing grasslands, cutting down trees, burning a forest and clearing some area of vegetation. Loss of habitat results in annihilation of species of endemic plants, microorganisms and forcing out of animals which in alien lands die out after some time. Migrating animals would go astray and get killed.
(ii) Over-exploitation - Excessive exploitation of a species, whether a plant or an animal, reduces size of its population so that it becomes vulnerable to extinction. Due to over-exploitation by humans, Dodo, three subspecies of tiger and Steller's sea cow have become extinct in the last 500 years.
(iii) Alien species invasions - Non-native or alien species are often introduced by man for their economic and other uses. They often become invasive and drive away the local species. For example, water hyacinth (Eichhornia crassipes) was introduced in Indian waters due to its aesthetic value but turned out to be a problematic species. It clogged water bodies including wetlands at many places resulting in death of several aquatic plants and animals.

29. (a) (i) Viral DNA is produced by reverse transcriptase.
(ii) New viral RNA is produced by the infected cell.

OR

Infected cell survives but T-lymphocytes decrease in number due to replication and release of virus.
(b) Retrovirus are called so because viral DNA is produced from viral RNA by reverse transcription,
e.g., HIV.
(c) AIDS is caused by the Human Immunodeficiency Virus (HIV) a retrovirus. Transmission of HIV infection generally occurs by (i) sexual contact with infected person, (ii) by transfusion of contaminated blood and blood products, (iii) by sharing infected
needles and (iv) from infected mother to child during pregnancy.

30. (a) In the given representation of evolution of man, X and Y represent Homo erectus and Australopithecus, respectively.
(b) Homo erectus (X) had a large brain around 900 cc.

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(c) Australopithecus (Y) was with bipedal locomotion, omnivorous diet and had erect posture. It had human- like teeth. Its brain capacity was about 500 cc.

OR

Fossil of Homo erectus was discovered in Java in 1891.

31. (a) Providing sex education is one of the most effective ways to create a reproductively healthy society because:
(i) It will provide the pre-requisite knowledge to the curious adolescents, which will prevent them from getting misguided.
(ii) It will create awareness about STDs (sexually transmitted diseases) and ways to prevent and cure them.
(iii) It will teach methods of family planning and taking care of a female during pregnancy.
(iv) It will also create awareness about topics such as infertility and different methods of curing the same.
(b) Two indicators of reproductively healthy society are:
(i) Reproductively healthy society does not emphasise on a single sex. In such society, the female and male sex ratio is maintained. Moreover, due to implementation of family planning measures, the population size is under control.
(ii) A reproductively healthy society has fewer incidences of diseases related to reproductive system and few cases of spread of sexually transmitted diseases. Incidences of death of pregnant women or foeticide due to complicated pregnancies are much reduced due to availability of precise health care for pregnant women.

OR

(a) Fertilisation i.e., the fusion of sperm and egg induces the completion of meiotic division of the secondary oocyte.
(b) The ovum released by the ovary is transported to the ampullary-isthmic junction where fertilisation takes place. During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and haploid ovum (ootid). Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote having 23 pairs of chromosomes. Implantation is the attachment of blastocyst to the uterine wall. It occurs after 7 days of fertilisation. As zygote moves towards the uterus, it undergoes series of mitotic

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divisions known as cleavage and forms 2, 4, 8 and 16 daughter cells called blastomeres. The embryo with 8 blastomeres is called morula. The morula transforms into blastocyst. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

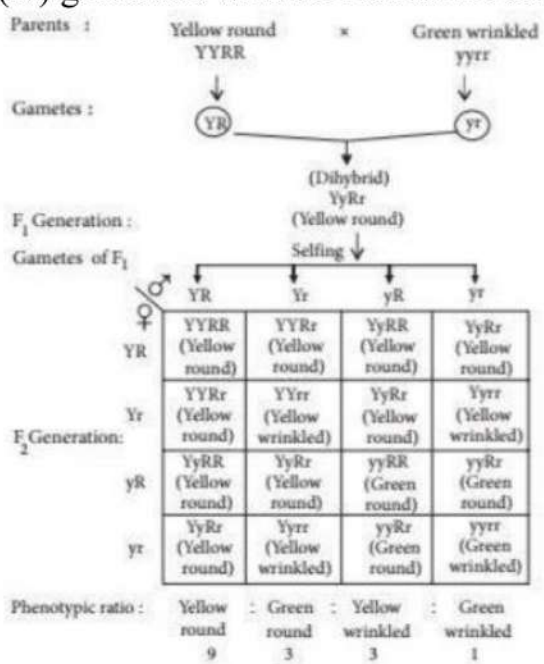
32. Law of independent assortment states that the allele of two pairs of a trait separate independently of each other during gamete or spore formation and get randomly rearranged in the offspring at the time of fertilisation producing both parental and new combination of traits. This can be explained by the following typical example of Mendelian dihybrid cross. Mendel performed crosses involving two characters (dihybrid crosses) that made to study inheritance of two pairs of genes. The classical example of dihybrid cross given below is the use of two pairs of characters namely the seed colour and seed shape. The plants with yellow and round seeds (pure) were crossed with those having green and wrinkled seeds (pure). The F_1 seeds were yellow and round. F_1 plants were selfed and F2 seeds obtained which showed all the four possible combinations, i.e.,

(i) yellow and round seeds,

(ii) yellow and wrinkled seeds,

(iii) green and round seeds, and

(iv) green and wrinkled seeds in 9:3:3:1 ratio. It can be shown by the following cross.



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OR

Tall pea plant with violet coloured flower could have four possible genotypes: TTVV, TtVV, TTVv and TtVv. Case I: Homozygous tall plant with violet colour (homozygous) flower is selfed.

Parents: TTVV × TTVV

Gametes: TV TV TV TV

F_1:	TV	TV
TV	TTVV	TTVV
TV	TTVV	TTVV

If plant produce all tall plants with violet flowers as offspring, then genotype of plant is TTVV. Case II: Heterozygous tall plant with (homozygous) violet coloured flower is selfed.

Parents: TtVV × TtVV

Gametes: TV tV TV tV

F_1:	TV	tV
TV	TTVV Tall violet	TtVV Tall violet
tV	TtVV Tall violet	ttVV Dwarf violet

If plant produces tall plants with violet flowers and dwarf plants with violet flowers in the ratio of 3:1 as offspring, then the genotype of parent is TtVV. Case III: Homozygous tall plant with violet (heterozygous) flower is selfed.

Parents: TTVv X TTVv

Gametes: TV Tv TV Tv

Progeny:	TV	Tv
TV	TTVV Tall violet	TTVv Tall violet
Tv	TTVv Tall violet	TTvv Tall white

If the plant produces tall plant with violet flower and tall plant with white flower in the ratio of 3: 1 as offspring then the genotype of parent is TTVv. Case IV: Tall plant with violet flower (heterozygous for both the trait) is selfed. If the plant produces tall plant with violet flower and tall plant with white flower in the ratio of 3: 1 as offspring then the genotype of parent is TTVv.

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Case IV: Tall plant with violet flower (heterozygous for both the trait) is selfed.

Parents : TtVv × TtVv

Gametes : TV, Tv, tV, tv TV, Tv, tV, tv

F_1 :	TV	Tv	tV	tv
TV	TTVV Tall Violet	TTVv Tall Violet	TtVV Tall Violet	TtVv Tall Violet
Tv	TTVv Tall Violet	TTvv Tall White	TtVv Tall Violet	Ttvv Tall White
tV	TtVV Tall Violet	TtVv Tall Violet	ttVV Dwarf Violet	ttVv Dwarf Violet
tv	TtVv Tall Violet	Ttvv Tall White	ttVv Dwarf Violet	ttvv Dwarf white

Tall violet : Tall white : Dwarf violet : Dwarf white

9 : 3 : 3 : 1

If the above given ratio is obtained, then the genotype is TtVv.

33. (a) The two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) are required in each cycle of polymerase chain reaction. Primers hybridise to target DNA region and allow synthesis of the DNA towards one another whereas DNA polymerase synthesise DNA region between the primers using dNTPs and Mg2+. Taq DNA polymerase is isolated

Denaturation of ds DNA
↓
Genomic DNA template
↓
Chemically synthesised oligonucleotides (Primers)
↓
Complementary regions of DNA
↓
Thermostable DNA polymerase
(from *Thermus aquaticus*)
↓
dNTPs (Nucleotides) provided
↓
In vitro synthesis of copies of DNA of interest

(a) The figure E. coli cloning vector pBR322 is as follows:

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Origin of replication (ori): This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin support high copy number. rop: rop codes for protein involved in the replication of plasmid amp: gene for ampicillin resistance which help in selecting transformants.

(b) Biolistic gene gun helps in the process of gene transfer into the host cell without using a vector. In biolistic method or gene gun method, tungsten or gold particles coated with foreign DNA are bombarded into target cells at a very high velocity. This method is suitable for plants, but is also used to insert genes into animal that promote tissue repair into cells (particularly cancer of mouth) near wounds. It has made great impact in the field of vaccine development.

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